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COMPLIMENTS
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CONICAL CORNEA—AN HISTORICAL REVIEW TOGETHER WITH A NEW NON-OPERATIVE METHOD OF TREATMENT.

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From the remote ages of antiquity alterations in the curvature of the cornea have, no doubt, attracted the attention of careful observers in medicine, but the classification and consequent systematic study of these variations have until comparatively recent years been greatly neglected, thus accounting for the inability to properly treat this condition. It is not unlikely, that many of these abnormalities in curvature escaped detection in cases in which the cornea remained perfectly transparent.

Conical cornea, as we understand it at the present does not seem to have been known to the ancients, as no satisfactory account of it is to be found in the writings of the Greeks, in Roman literature, or in the books of the Arabians. It is possible, however, that Ali Ben Isa in his systematic work on Anatomy, Physiology and Diseases of the Eye described it. Ambroise Pare[1] alludes to the incurability of corneal staphyloma, but whether he included conical cornea within this term is a matter of considerable conjecture. Perhaps the earlier systematic study of the condition is to be found in the dissertation on "Staphyloma Diaphanum" published by Mauchart at Tubingen in 1748. Demours[2] states that his father had noticed it as long ago as 1747.

The various terms by which the affection was known accounts in part for the lack of definite knowledge concerning it. Many of the ancient medical writers no doubt observed the abnormality but described it under terms most convenient for their use. This lack of uniformity consequently resulted in endless confusion. Taylor in 1766 in his Nova Nosographia Ophthalmica described it under the name "Ochlodes." Scarpa in 1801 observed a case of conical cornea in a female but from his description of it he was greatly perplexed as to its true nature and included it under "Staphyloma." By reason of its translation into most all of the modern languages, the work of this distinguished surgeon spread a knowledge of conical cornea throughout all the civilized countries of his time, although by some there was a tendency to attribute this particular observation to Leveille, the French translator.

Apart from these, the ancient writings on this subject, as before stated, are much hazed if they exist at all. In the warm countries of Europe it must have been of extreme rarity as it escaped the keen observation of Garcia and Don Jose Alarson. In Holland the Dutch translation of Reute's work is perhaps one of the best early descriptions. In Germany the condition is said to have been well-recognized as early as 1754. In the latter part of the eighteenth century, however, it was as yet very little known as Beer had never satisfactorily described it and Himly, of Goettingen, had never seen it. Beer[3] mentions that there is a kind of staphyloma in which the cornea is inconceivably distended but does not lose its transparency. In one case he observed the vision was markedly diminished, but the true nature of the condition failed of detection. Richter[4] states in his work that he had never seen the affection. To Burgman[5] is accredited the history of a very remarkable case in which the cornea of both eyes of a person who was hanged were so prodigiously extended that they reached to the mouth like two horns. (Nottingham, in commenting on this case, wittingly remarks that without a doubt it belongs to the poetry of the subject.) Benjamin Bell[6] in his writings confused dropsy of the anterior chamber and staphyloma with conical cornea, as had been done by many other observers of his period. Demours treated of it under the title of transparent staphyloma.

The discovery of astigmatism by Thomas Young[7] and its subsequent study by Airy, Donders, Helmholz, and other observers in the early part of the nineteenth century aided in clearing up the confusion that existed at this period regarding variations in corneal curvature. The knowledge of the fact that Airy was the subject of myopic astigmatism and believed the affection to reside in the crystalline lens no doubt greatly influenced Sir William Bowman[8] who suggested and practiced removal of the lens in the treatment of conical cornea. He believed that the form assumed by the cornea was the effect of a morbid growth of that structure and the short sight of the patient was to be attributed to the increased refractive power of the part which together with that of the crystalline lens brought rays to a focus far short of the retina. This being the case he concluded that as it was impossible to remove the morbid state of the cornea without rendering it more or less opaque, a useful degree of vision might be restored by removal of the lens. He was subsequently able to substantiate this by the case of a woman in whom both cataract and conical cornea were present. After removal of the lens she was able to see very well without the aid of the convex lenses usually employed in aphakia. In another case of his, that of a young girl with conical cornea, who possessed little more than protective vision, he removed the lens by the operation of discission and one year later she possessed good reading and distance vision without convex lenses which when used served to blur the sight very much. The similarity between these histories and the records of cases of high myopia reported recently by Sir William J. Collins[9], A. Bronner[10] and other European ophthalmologists can not but suggest the possibility of error in diagnosis in Adam's cases.

With the distinguishing of conical cornea from astigmatism and staphyloma, the true nature of the cornea in keratoconus became the subject of considerable discussion. Adams, as we have already seen, described it as a morbid thickening growth of the substance of the cornea, while Wardrop[11] believed it to arise in consequence of a change in the structure of that organ. He states that in cases which he had examined there was irregularity of the cornea in a small area, having very much that appearance which is usually observed when a thin pellucid membrane fills up a part of the cornea that has previously been destroyed by ulceration. This irregular portion of cornea at the apex is generally very thin and sometimes becomes clouded and opaque. The views of Jaeger,[12] of Erlangen, serve to confirm these observations. In dissecting eyes affected with conical cornea he found that the apex of the cone was very thin but the circumferential portion was thickened. Middlemore[13] observed a case in which the laminae of the cornea were less movable on each other than normal; its circumference was of natural thickness, but the apex was much thinner than usual and opaque on its exterior only. Walker likewise found that the cornea was generally much thinner than normal in this affection, especially in its central portion.

Guthrie[14] stated that the cornea was decidedly thinner than usual in this condition and that in the presence of irritation the apex of the cone became opaque and represented in shape a conical staphyloma. Sanson in 1836, on the other hand, published a statement in which he claimed that the anterior or prominent part of the cornea is hypertrophied or converted into a solid, thick and transparent piece; an opinion not unlike that of Sir William Adams. Mackenzie[15] believed it to be due to faulty nutrition of the cornea and suspected it arose sometime from thinning of that structure attending a transparent cicatrix or dimple such as follows phlyctenulae.

Perhaps the first observer to study the condition properly was Nottingham,[16] of Liverpool, who carefully described it and distinguished it from staphyloma. His period of the nineteenth century was rich in ophthalmic discoveries and with the practical application of the knowledge of astigmatism in its several varieties and its correction by cylindrical lenses by Donders, Dyer, MacAllister and others, the number of cases of conical cornea became considerably less. Nottingham's observations were not confined to human beings, but extended through the domain of comparative anatomy. He states that in 1852 he noticed conical cornea in the eyes of a goldfish, but had never noticed a case of true conical cornea in the dog, although in more than one instance in carefully made autopsies he found a thinned condition of the central portion which was very faintly opaque but without conical elevation. Apparent blindness was the rule during life in these cases.

From the foregoing statement it may be easily seen that there existed many widely different opinions regarding conical cornea and for purposes of further discussion I take the liberty of stating the accepted definition of the condition of the present period. Conical cornea may be said to be a conical protrusion of a transparent cornea due to increased intraocular pressure and thinning of its central portion. It never ruptures spontaneously. While this definition serves for classification purposes it is insufficiently descriptive so that the following quotation from Mackenzie[17] seems appropriate at this time: "In the earliest period of this disease shortsightedness is the principal effect which it produces on vision; when more advanced nothing is seen by the patient through the center of the cornea; all the sight which he enjoys is either over the nose, or toward the temple, and in its sphere is extremely limited. Still, however, by strongly compressing the eye with the half closed lids, or with the finger, so as to limit the pupil and bringing the object close toward one or the other side of the eye, generally toward the temporal, the patient is sometimes even able to read. The objects appear multiplied to an eye the subject of conical cornea owing to inequalities in the curvature." This multiplicity of images is designated as *polyopia monocularis.* Sir David Brewster was among the first to notice this symptom. In a patient of Wardrop[18] examined by Brewster there was the complaint that a candle held before the eye was multiplied five or six times. By holding a candle fifteen inches from the cornea and keeping his eye in the path of the reflected rays, Brewster observed variations in the size and form of the image of the candle. The reflected image regularly decreased in size when it passed over the most convex parts of the cornea, but when it came to the part nearest the nose it alternately expanded and contracted and underwent such alterations as to indicate the presence of a number of spherical eminences and depressions. Strange as it may seem it is yet true, that none of the many observers of this affection, ancient or modern, with the exception of Nottingham, have called attention to the *absence of chromatic aberration.*

The objective examination of an eye the subject of conical cornea is always very satisfactory. Viewed from in front the eye has a peculiarly brilliant and sparkling appearance and sometimes resembles a drop of clear water upon a convex glass surface. Viewed in profile, owing to the double refraction of light, the cornea appears dark between the apex and base of the cone. When the examination is conducted in a darkened room one sees by the aid of the ophthalmoscope an interrupted wavy reflex instead of a clear red one. The annular shadow seen in this way is particularly characteristic and was first pointed out by Sir William Bowman[19]. On throwing the light upon the cornea a bright reflection is received through the center of the cornea which gradually shades off and becomes darker toward the base so that the central bright spot is surrounded by a dark zone which in turn is again encircled by a red ring. If a light is thrown upon the center of the cornea at different angles the side of the cone opposite the light is darkened. The central red zone (in which is obtained a reverse image of the fundus) is due to the reflection of the fundus through the central conical portion of the cornea and the outer red ring to the reflection through the normal peripheral portion.[20] The corneal reflex is suddenly elongated when the eye is rotated in different directions. In the opinion of Knapp[21] the dark zone is due to diffusion and complete reflection of the rays of light at the base of the cone, where it passes over into the normal curvature of the cornea.

Donders[22] has shown that on the ophthalmoscopic examination of such an eye there is considerable parallax on moving the convex lens (Helmholtz's Ophthalmoscope) in front of the patient's eye. A displacement of a portion of the disk and retinal vessels results similar to that seen in glaucomatous excavation of the nerve.

The causes of this very interesting affection are unknown. The normal variations in the shape of the cornea in the members of the animal kingdom may in part account for it. Thus it is seen that the cornea is flat in fishes and aquatic animals; curved in large animals, mammalia, and birds and rounded in the extreme in high flying birds of prey. It has been stated that on account of the texture of the cornea being more spongy in young persons than in adults it is more liable to staphyloma and keratoconus during youth and early adolescence.[23] Wardrop states that the cornea is most convex at the earlier periods of life and according to his observations it is liable to acquire its greatest degree of convexity about the age of puberty. Conical cornea rarely if ever begins after maturity; most cases occurring in girls between the ages of ten and sixteen years. This fact induced Henry Power to believe that it was due to menstrual disorders, but Lawrence[24] states that he has seen it in perfectly healthy country girls and in healthy subjects in whom no constitutional cause whatever could be detected. It usually begins in one eye and after a time also attacks the fellow eye.

It may be congenital or post-natal. Wardrop observed it in a boy of eight years. Ammon[25] states that he encountered it in several sisters who had labored under it from birth. Wilde is responsible for the assertion that in the congenital form both eyes are involved, but Cooper had never seen a case which he could regard as congenital. The latter observer attributed it to—1, An enfeebled state of constitution and a low condition of nervous energy; 2, congestion; 3, ulceration of the cornea; 4, inflammation of the cornea; 5, excessive weeping. Mackenzie had seen it follow scarlatina and traumatism and occasionally as a sequence of prolonged weeping. Nottingham relates instances in which it followed keratitis and traumatism and Wimme,[26] *Zeitschrift für die Ophthalmologie,* gives an account of three cases associated with a peculiarity in the shape of the head.

From statistics collected from various sources it has been shown that conical cornea occurs with greatest frequency in Asia among the Mongolians, particularly in Chinese. This may be in part accounted for by the greater prevalence of ophthalmia in these regions (Nottingham, in his study of the subject, thoroughly digested all the available statistics of his period, from which I take the liberty of abstracting). The report of the eye cases in the hospital at Chusan, as given by Mr. Lockhart in the Chinese Repository for 1841, Vol. X, shows that out of 1,554 cases more than 1,500 were attended by corneal affections. In 342 cases observed by Hobson at the same period, 260 were attended by disease of the cornea. From these and other reports it may be easily seen that in these countries there is a greater tendency toward diseases of the anterior portion of the eye than in other countries. It has been suggested that conical cornea, as it occurs in China, is in some way connected with the pyramidal or conical-shaped head characteristic of the Chinese people. This has not been confirmed by observation, as in the Esquimaux and other widely separated races in which pyramidal-shaped heads are common, conical cornea does not seem to be of frequent occurrence.*

Ophthalmia is, no doubt, a frequent factor in the production of the condition. Julian Van Roosbroeck, of the University of Ghent, observed it in numerous instances as a result of this cause among the soldiers of Flanders. He devised a special treatment for it which will be considered later. The influence of climate is such that its consideration can not be ignored, yet upon careful reflection it can not but appear to bring about its effect in a very indirect manner. In warm countries ophthalmia is very prevalent and this fact is potent in directing attention toward climate as an etiologic factor. M. W. Cooper[27] shows as a result of his statistical studies that it is unknown in the north of Germany; in the north of England it is less common than in the south and west; in Scotland rarer than in England, while in China it would seem to be of common occurrence. In 208,970 ophthalmic cases, upon which Cooper's calculations were made, 194 were examples of conical cornea giving a general average of one in 1077.16. Isaac Hays[28] states that in Philadelphia (1854) he had seen but two cases. In the enormous service at the Medico-Chirurgical Hospital, Philadelphia, during the past ten years I have seen but five well marked instances of the affection. The rarity of the condition at present is accounted for by the ease with which we are able to exclude cases of mixed and irregular astigmatism.

The influence of the nervous system in the production of conical cornea deserves passing mention. As early as 1712 it was shown by Pourfour du Petit that division of one-half of the great sympathetic in dogs would produce nutritional ocular disturbances manifested by changes in the cornea. Hannover,[29] in the first half of the nineteenth century, published a detailed report of experiments relating to the modified nutrition of the cornea after removal of the superior cervical ganglion of the sympathetic. J. H. Pickford,[30] however, was the first to associate conical cornea with disturbances of the sympathetic nerves. He believed that it was due to some disturbance of the function of the great sympathetic and par vagum which was reflected through the lenticular ganglion and fifth nerve to the nutrient vessels of the cornea itself, and he devised a treatment with a view of remedying this disturbance. Kirke and Paget held views similar to those of Pickford.

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*My own personal experience demonstrates the extreme variety of conical cornea among the Indians. In over 4,000 Indian children examined I have encountered the affection but twice, once in a girl belonging to the Oneida tribe, Wisconsin, and once in a half-breed male of the Chinook tribe, Washington. During a recent visit to Alaska I had occasion to examine at Sitka and Douglas Island over 500 native Alaskan Indians, who are grouped in four classes, viz., Koloshians, Kenainans, Aleuts, and Esquimos, and in none of these was it possible to detect the slightest suspicion of this condition.

Treatment.—In the review of the treatment of conical cornea there is, as in its description, much of interest. Many of the older surgeons denied the possibility of restoring vision to any degree in most cases, yet Sanson has related a case in which spontaneous cure took place after the affection had existed several years. On account of the dearth of optical apparatus, most of the early methods of treatment were surgical in character. The seton was employed by Flarer, an Italian surgeon, who passed a fine needle, carrying a delicate silk thread, through the affected tunic.

Benjamin Bell[31] was among the first to perform paracentesis of the anterior chamber in this condition. His method consisted in passing a knife or flat trocar behind the iris, after which a seton was employed. Littell[32] used silver nitrate in solution with a view to lessening any incipient opacity present in the apex of the cone.

Gervis employed a treatment which may be quoted as follows: "With a view to breaking up the laminæ of the projecting cornea and to promote absorption of what I considered its thickened structure or hypertrophy, I punctured it several times with a couching needle and about three times a week applied to the conical center argentum nitrate, making a sweep across it; the puncturing with the needle produced some opacity of the globular-shaped projection, just as is seen after severe inflammation of the cornea.

Tyrrell[33] was successful in relieving several cases by altering the position of the pupil. He punctured the cornea with a broad needle near the corneo-scleral margin at the lower and outer part, after which he introduced a small blunt hook to catch the pupillary margin of the iris, and drew it out far enough to bring the pupil from the center to the lower and outer part of the cornea. The prolapsed portion is then allowed to remain or may be cut off with scissors. According to Wharton Jones,[34] Adams and Middlemore had previously proposed the same operation. Sir William Adams' name is, however, more closely associated with the operation for removal of the lens, which he performed with success in this condition.

M. Desmarres[35] advocated puncture of the cornea, after which light but long continued pressure should be applied. Shortly afterward Mackenzie published the statement that evacuation of the aqueous humor was of no value whatever in this condition. Division of the recti muscles in conical cornea had been suggested some time prior to 1854, but was not seriously considered. G. J. Bull's recently reported case[36] of astigmatism, in which a cure was effected by a complete subconjunctival tenotomy of the external rectus, indicates the possibility of relief in conical cornea by this means. Fario, an Italian surgeon, produced drainage of the aqueous humor by excision of three small portions of the cornea. Vision was improved by this procedure.

Von Graefe,[37] in an interesting case of conical cornea, produced ulceration of the apex of the cone and subsequent contraction and flattening of the cicatrix. His operation consisted in passing a very small cataract knife (Von Graefe model) into the middle layers of the cornea just at the apex of the cone to the extent of about one line, after which it is withdrawn; a small superficial flap is thus formed, which is seized with a very fine pair of forceps and snipped off at its base with a pair of curved scissors in order that a superficial gap may be left at this point. Great care should be exercised in entering the knife to prevent its penetration of the entire thickness of the cornea; should this occur the operation should be postponed for a few days until the perforation closes. On the day following the operation a finely pointed stick of mitigated silver nitrate is lightly applied to the floor of the gap and immediately neutralized by a saline solution. The application is repeated at intervals of from three to six days until a slight, faintly yellowish infiltration is formed. Atropine should be instilled and a bandage applied to guard the eye from exposure. Improvement becomes manifest only after the infiltrate undergoes contraction, and this usually requires about five or six weeks.

Bader[38] reported nine cases in which a more or less flat cornea was produced by the following method of treatment. A delicate curved needle, carrying fine silk or silver wire, is passed through the cornea in its horizontal diameter close to the point of the cornea to be removed. The point of the needle is then carried horizontally across the anterior chamber and is thrust through a point of the cornea opposite to the point of entrance and close to the portion of the cornea to be removed. The needle is left in the cornea until the top of the cone has been removed, as it serves to protect the lens. The head of the needle is held in one hand and the lower half of the cone is divided with a Beer's knife, the needle is then released, the small flap seized with an iris-forceps, and the rest of the cone removed with scissors. The needle is then drawn completely through the cornea and the ends of the thread tied so as to unite the edges of the wound.

Nottingham states that up to 1854 neither transplantation or glazing of the cornea had been thought of in England. Transplantation as recommended by Himly had been tried in Germany, France and America, but without success. Nussbaum proposed glazing of the cornea after experimenting with the operation on rabbits. He prepared a sort of glass button with two little offsets or folds to enable it to hold on and be steady in the cornea; a short transverse incision is made in the cornea and the glass piece, as it were, buttoned in, and this can be done without any after and long continued irritation of the eye. In his rabbits, Nussbaum states that the glass remained fixed and steady.

Nunnely modified Graefe's operation by cutting off the corneal flap and uniting the edges of the wound with delicate sutures. Solberg Wells[39] believed iridectomy to be the best operation. Bowman's treatment consisted in removing a small apex of the cone by means of a trephine. Multiple punctures of the cornea were recommended by Tweedy. Chisholm perforated the cornea by means of a needle heated to white heat, and the galvano-cautery has been employed by Knapp, Swanzy, Critchett, Williams, Bickerton, and other ophthalmic surgeons.

Non-Operative Treatment.—It is extremely interesting to note that medical treatment enjoyed a certain vogue in the management of this annoying affection even after its true nature was recognized. Van Roosbroeck employed a strong solution of tannin in Peruvian or oak bark in addition to cauterization with the solid stick of silver nitrate. Pickford[40] used emetics and purgatives with the view of influencing the sympathetic system. His favorite prescription was: ℞ Zinci Sulphat. ℨ i. Mag. Sulph. ℨ iv—*primo mano quotidie sumend.* Littell advised that the patient should abstain from all close exertion of the eye and suggested the use of belladonna. Arlt, Wallace, and Stenheim, working individually, found improvement to follow the use of eserine and a pressure bandage. Mackenzie showed that the progress of the affection might be materially retarded by rest of the eyes, exercise in the open air, attention to the bowels, and tonics, such as quinine.

Of the optical devices, perhaps the first employed in this condition was the pin-hole disk recommended by Travers,[41] coupled with which it is advised to employ such measures as blistering and tonics. Hull[42] reported benefit from an instrument made up of two lenses with an adjustment, the object glass large and convex; the eyeglass smaller and doubly concave; the entire arrangement being not unlike that of an opera glass. Abraham, an optician in Bartlet street, Bath, used a similar instrument with success and modified it by the use of an additional concave lens of small size fitted in an opaque circle wide enough to act as a diaphragm. Wharton Jones produced benefit by means of concave lenses in a number of instances, and a similar observation was made by Sir David Brewster.

To Nottingham we are indebted for much of the valuable information in regards to the early optical appliances used. He relates one case in which benefit was derived from wearing before the eye a piece of black wood, in form more or less like a walnut shell, perforated so as to leave a circular opening, beyond and around which a small nipple projected on the exterior, thus converting the hole into a very short tube standing on the outer surface of the shell of wood. The openings were made to one side of the center. This apparatus was used in combination with darkened double concave glasses for distance and concavo-convex cylinders for reading fine type.

Nottingham likewise devised an instrument for drawing the lids up and close on the eyeball for the relief of conical cornea, which may be described in his own words as follows: "It consists of a steel spring with a small round pad, a little larger than a sixpence, at the end of it, the pad lined with soft material being placed upon the temporal integument which has previously been drawn outward and backward by the fingers. A *point d'appui* is easily given to such a spring by allowing it to pass downward and forward toward the canthus, upon which it has to act, from another spring encircling the fore part of the head, in shape like a horseshoe and completed by an elastic band carried around the occiput, so as to form a kind of fixed and steady headband, upon one point of which, more or less near to the parietal prominence part of it, the end of the other may be riveted so as to permit a little forward or backward motion at the joint. A slight inclination upward of the outwardly drawn canthus has a tendency to improve the result.

Nottingham further recommends trying different forms of artificial iris such as the following:

1. The flat disk of blackened metal with a pupillary opening in the middle, so arranged that it may be readily centered with the pupil.
2. A similar disk of blackened metal with a transverse slit in-

stead of a central foramen. They should be round to permit of turning of the axis of the slit.

3. The small black cup of ebony or other dark or hard and blackened wood, the concavity to be turned toward the eye, and with the pupillary aperture in the center.

4. The concavo-convex of wood eccentric foramena so that the pupillary aperture in the wood may be toward the inner side, thus favoring convergence of the two eyes; but at the same time, by turning, admitting of the aperture in either piece being more or less outwardly directed.

During the first half of the nineteenth century an American invention called "eye-cups" was much exploited as of value in altering the curvature of the cornea. Two eye-cups were employed, each consisting of a hollow sphere of India rubber, to which was connected a cup of hard wood, shaped like an egg-cup, the interior of the two communicating so that if the India rubber ball be first pressed and then the edge of the wooden cup be applied to the cheek, closed eyelids, or other part, the sudden expansion of the caoutchouc sphere permits rarefaction of any atmospheric air which is confined and induces suction. It was directed that for the first week the cup should be used every night for five minutes and afterward nightly for ten minutes. Mackenzie suggested the use of a deep concave lens with a movable diaphragm behind it attached by a hinge to the spectacle frame in which the lens is fixed. The diaphragm may have either a hole in the center or a narrow transverse slit.

Sir John Herschell[43] suggested the application of some transparent animal jelly in a spherical capsule of glass in contact with the surface of the eye. He likewise suggested taking a mold of the cornea and impressing it upon some transparent medium. Both of these procedures have been found impracticable.

In an experience extending over twenty years I have failed to obtain any marked improvement in these cases from any of the modes of treatment already mentioned, but the work of Nottingham has prompted me to further elaborate on the optical methods used by him so that I am able to report one case in which almost normal vision was acquired and maintained.

This patient had an elliptical portion of the cone removed by myself, but no marked improvement followed. A series of experiments extending over a period of several years were performed in an effort to adapt some form of disk that would permit rays of light to enter the eye through the least refractive portion of the cornea. The investigation began with a pinhole disk and stenopaic slit, and included the testing of every form of prism and patch until a satisfactory result was obtained. The conclusions reached were as follows:

1. That the character of the disk and its angle vary in each case.
2. That the intelligence of the patient is an indispensable adjunct in the selection of the necessary disk, as the method is almost entirely subjective.
3. That lenses in which the corneal area is screened by black patches of various sizes and shapes containing the requisite slits are better adapted for this purpose and are less noticeable than prisms or ground glasses.
4. That the refraction of the cornea varies from time to time, requiring frequent examinations with changing of the disks.
5. That the incorporation of the patches with the correcting lenses gives rise to an additional improvement.
6. That the only disadvantage lies in the fact that the patches do not correspond to the cornea during ocular movement, but this is compensated for by the marked improvement and comfort afforded when the eyes and disks are adjusted for some average range.
7. That a fair trial should be made with these disks before resorting to operative procedure.

In other cases this method has been employed with very gratifying results, but in this particular case vision was brought to 6/9 and 6/12, and work at close range was comparatively easy when a disk with a smaller aperture was employed.

The quotation, in part, of this patient's letter describing this procedure is as follows:

"Of these small black opaque disks, I find the one with the round opening to serve my purpose best, for distance as well as for reading, when used in front of the left eye. To this particular disk I have devoted much time and attention, having experimented with a number of different sized openings—round and otherwise—in order to find the 'happy medium' for all needs and requirements, and I know I have found it in this size. It serves me well on plane glass, and remarkably well when used in connection with the D D concave cylinders. So much for the left eye.

"Now, as regards the right or near-sighted eye of mine, I obtain the best results for this eye with the half-disk which has the small V cut into the center of same, for reading purposes, and at the same time answers quite well for distance, but then only in twilight and not otherwise. As you will notice, this latter, or V-shape, is a part of and has the same dimensions as the 'triangle' disk, and to which I have also given a great deal of attention and experimented with various sizes before finally deciding on this as being the best for the purpose—reading—and which I find especially so when used in conjunction with the 9 D cylinders."

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